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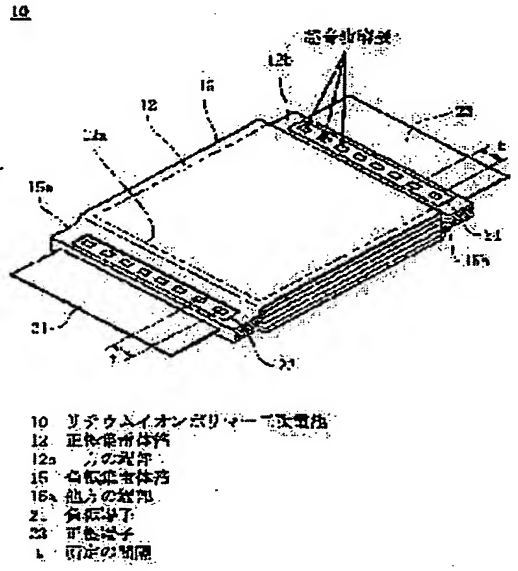
(54) LITHIUM ION POLYMER SECONDARY BATTERY

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce resistance in a terminal junction part while securing flexible nature.
SOLUTION: Two or more positive-electrode collector foils 12 and two or more negative-electrode collector foils 15 are laminated through a polymer electrolyte layers 17, and one side of an end part 12b of a plurality of positive-electrode collector foils and another side of the end part 15a of a plurality of negative electrode collector foils 15, are laminated, respectively. An one end part of a positive-electrode terminal 23 is connected to all the one end parts 12b of the two or more positive-electrodes collector foils 12 by inserting the one end of the positive-electrode terminal 23 between all the one end parts, where the two or more positive-electrode collector foils are laminated, and also by carrying out ultrasonic wave welding at two or more places in the insertion state with putting predetermined intervals t in a direction crossing to an insertion direction. An one end part of a negative-electrode terminal 21 is connected to of all the other side end parts 15a of the two or more negative-electrode collector foils 15 by inserting the one end of the negative-electrode terminal 21 between all the other one end parts where the two or more negative-electrode collector foils are laminated, and also by carrying out ultrasonic wave welding at two or more places in the insertion state with putting predetermined intervals t in a direction crossing to an insertion direction.



10 リチウムイオンポリマー二次電池
12 正極集電体箔
12a 一方の端部
15 負極集電体箔
15a 他方の端部
21 負極端子
23 正極端子
t 所定の間隔

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[Claim(s)]

[Claim 1] Positive active material (13) is applied to each front face of two or more positive-electrode charge collector foils (12). A negative-electrode active material (16) is applied to each front face of two or more negative-electrode charge collector foils (15). The laminating of two or more of said positive-electrode charge collector foil (12) and said two or more negative-electrode charge collector foils (15) is carried out through a polymer electrolyte layer (17), respectively between said positive active material (13) and said negative-electrode active materials (16). The end of a sheet-like positive-electrode terminal (23) is connected to one [all] edge (12b) of two or more of said positive-electrode charge collector foils (12) which project from one edge (15b) of said negative-electrode charge collector foil (15). The end of a sheet-like negative-electrode terminal (21) is connected to all the other-end sections (15a) of two or more of said negative-electrode charge collector foils (15) which project from the other-end section (12a) of said positive-electrode charge collector foil (12). In the lithium ion polymer rechargeable battery by which the layered product of said positive-electrode charge collector foil (12) and said negative-electrode charge collector foil (15) was sealed with a package (26) so that the other end of said positive-electrode terminal (23) and the other end of said negative-electrode terminal (21) might be expressed The laminating of one [all] edge (12b) of two or more of said positive-electrode charge collector foils (12) and all the other-end sections (15a) of two or more of said negative-electrode charge collector foils (15) is carried out, respectively. The end of said positive-electrode terminal (23) between one [all] edges (12b) where the laminating of said two or more positive-electrode charge collector foils (12) was carried out The end of said positive-electrode terminal (23) is connected to one [all] edge (12b) of two or more of said positive-electrode charge collector foils (12) by opening and carrying out two or more place ultrasonic welding of the predetermined spacing (t) in the direction which is inserted and intersects the path of insertion in the state of insertion. The end of said negative-electrode terminal (21) among all the other-end sections (15a) to which the laminating of said two or more negative-electrode charge collector foils (15) was carried out By opening and carrying out two or more place ultrasonic welding of the predetermined spacing (t) in the direction which is inserted and intersects the path of insertion in the state of insertion The lithium ion polymer rechargeable battery characterized by connecting the end of said negative-electrode terminal (21) to all the other-end sections (15a) of two or more of said negative-electrode charge collector foils (15).

[Claim 2] The lithium ion polymer rechargeable battery according to claim 1 a

positive-electrode terminal (23) and whose negative-electrode terminal (21) are an expanded metal or the punched metal sheet, respectively.

[Claim 3] The construction material of a positive-electrode charge collector foil (12) The reinforcement foil or reinforcement sheet metal (22 24) which is the same construction material as the construction material of a negative-electrode charge collector foil (15), has the thickness of 0.05-0.5mm, and has an area larger than the area of the ultrasonic welding per time Either [or] a positive-electrode charge collector foil (12) or a negative-electrode charge collector foil (15). Or the lithium ion polymer rechargeable battery according to claim 1 or 2 by which has been arranged on the laminating outside surface of both edges, and ultrasonic welding was carried out through said reinforcement foil or reinforcement sheet metal (22 24).

[Claim 4] There is no claim 1 whose predetermined spacing of ultrasonic welding the area of the ultrasonic welding per time is 2 5-200mm, and is 1-10mm, and it is the lithium ion polymer rechargeable battery of a publication 3 either.

[Claim 5] There is no claim 1 whose output of ultrasonic welding the frequency of ultrasonic welding is 10-60kHz, and is 0.2-50kW, and it is the lithium ion polymer rechargeable battery of a publication 4 either.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the lithium ion polymer rechargeable battery which carried out the laminating of positive active material and the negative-electrode active material through the polymer electrolyte layer.

[0002]

[Description of the Prior Art] Conventionally, the need over a thin and to some extent flexible cell is increasing by the spread of portable devices, such as a video camera and a notebook sized personal computer. The lithium ion polymer rechargeable battery formed as this thin cell by carrying out the laminating of a positive-electrode sheet and the negative-electrode sheet is known. This positive-electrode sheet is made by applying an active material to the front face of a positive-electrode charge collector foil, and a negative-electrode sheet is made by applying an active material to the front face of a negative-electrode charge collector foil. A polymer electrolyte layer is infixed between the active material of a positive-electrode sheet, and the active material of a negative-electrode sheet. By this cell, the positive-electrode terminal and negative-electrode terminal for taking out the potential difference in each active material as a current are prepared in a positive-electrode charge collector foil and a negative-electrode charge collector foil, and a lithium ion polymer rechargeable battery is created by sealing with a package the layered product by which the laminating was carried out in this way. In this lithium ion polymer rechargeable battery, the desired electrical and electric equipment is obtained by using the positive-electrode terminal and negative-electrode terminal which were pulled out from the package as a terminal of a cell.

[0003] Moreover, in recent years, the discharge capacity is expanded by folding up the positive-electrode sheet and negative-electrode sheet which are in the inclination to increase the discharge capacity of a lithium ion polymer rechargeable battery, carried out the laminating using the positive-electrode sheet of two or more sheets, and the negative-electrode sheet of two or more sheets, the discharge capacity was increased, or were made to expand the area of a single positive-electrode sheet and a single negative-electrode sheet, and were expanded in desired magnitude. or [, using a positive-electrode sheet and two or more negative-electrode sheets on the other hand] -- or it is required to connect mutually the edge of the positive-electrode charge collector foil of two or more sheets pulled out in the shape of a layer and a negative-electrode charge collector foil in connection with folding up and expanding discharge capacity, and to connect a positive-electrode terminal and a negative-electrode terminal. The

rechargeable battery which faces across this tied edge with the conductor which separates the edge of the positive-electrode charge collector foil of two or more sheets pulled out in the shape of a layer and a negative-electrode charge collector foil as this connecting means, and serves as a terminal in a bundle, welds the edge and conductor which were bundled, and took out the electrical and electric equipment through that conductor is proposed (JP,7-263029,A).

[0004]

[Problem(s) to be Solved by the Invention] However, when all the edges and conductors of the bundled positive-electrode charge collector foil or a negative-electrode charge collector foil are joined by welding, the mechanical strength in a part for the joint increases by welding, and there is nonconformity the flexible nature of a cell is lost. When the conductor which consists of a rod-like metal piece especially is used, there is flexibility in a part for the joint or a fault lost thoroughly. On the contrary, also although the flexible nature of a cell can be maintained when it inserts with the conductor which has flexibility comparatively and the conductor and the governed edge are welded selectively A clearance is generated between edges other than the part welded by incurvating a cell, and the conductor inserted from the outside, the conductivity in the part is lost, and there is a problem which resistance increases as a result and cannot obtain sufficient power. The object of this invention is to offer the lithium ion polymer rechargeable battery which can reduce the resistance in a terminal joint, securing flexible nature.

[0005]

[Means for Solving the Problem] As invention concerning claim 1 is shown in drawing 1 and drawing 2 , positive active material 13 is applied to each front face of two or more positive-electrode charge collector foils 12. The negative-electrode active material 16 is applied to each front face of two or more negative-electrode charge collector foils 15, and the laminating of two or more positive-electrode charge collector foils 12 and two or more negative-electrode charge collector foils 15 is carried out through the polymer electrolyte layer 17, respectively between positive active material 13 and the negative-electrode active material 16. The end of the sheet-like positive-electrode terminal 23 is connected to one [all] edge 12b of two or more positive-electrode charge collector foils 12 which project from one edge 15b of the negative-electrode charge collector foil 15. The end of the sheet-like negative-electrode terminal 21 is connected to all other-end section 15a of two or more negative-electrode charge collector foils 15 which project from other-end section 12a of the positive-electrode charge collector foil 12. As the other end of the positive-electrode terminal 23 and the other end of the

negative-electrode terminal 21 are expressed, the layered product of the positive-electrode charge collector foil 12 and the negative-electrode charge collector foil 15 is amelioration of the lithium ion polymer rechargeable battery sealed with a package 26.

[0006] As for the characteristic configuration, the laminating of one [all] edge 12b of two or more positive-electrode charge collector foils 12 and all the other-end section 15a of two or more negative-electrode charge collector foils 15 is carried out, respectively. The end of the positive-electrode terminal 23 between one [to which the laminating of two or more positive-electrode charge collector foils 12 was carried out / all] edge 12b The end of the positive-electrode terminal 23 is connected to one [all] edge 12b of two or more positive-electrode charge collector foils 12 by opening and carrying out two or more place ultrasonic welding of the predetermined spacing t in the direction which is inserted and intersects the path of insertion in the state of insertion. The end of the negative-electrode terminal 21 among all other-end section 15a to which the laminating of two or more negative-electrode charge collector foils 15 was carried out It is in the place where the end of the negative-electrode terminal 21 was connected to all other-end section 15a of two or more negative-electrode charge collector foils 15 by opening and carrying out two or more place ultrasonic welding of the predetermined spacing t in the direction which is inserted and intersects the path of insertion in the state of insertion.

[0007] Although the laminating of one [all] edge 12b of two or more positive-electrode charge collector foils 12 and all the other-end section 15a of two or more negative-electrode charge collector foils 15 is carried out, respectively and the positive-electrode terminal 23 and the negative-electrode terminal 21 are connected in invention concerning this claim 1 Since the connection is made by opening and carrying out two or more place ultrasonic welding of the predetermined spacing t Lifting of a mechanical strength can be controlled as compared with the case where all the parts of the edges 12a and 15b by which the laminating was carried out are joined, and the flexible nature which the sheet-like rechargeable battery 10 has from the former can be secured. Moreover, although there is a possibility that a superfluous oscillating burden may join a positive electrode and the negative-electrode charge collector foils 12 and 15, and a positive electrode and the negative-electrode charge collector foils 12 and 15 may be damaged by the oscillating burden when ultrasonic welding of all the parts of the edges 12a and 15b by which the laminating was carried out is carried out Since the oscillating burden is distributed and it decreases by opening and carrying out two or more place ultrasonic welding of the predetermined spacing t, a positive electrode and the negative-electrode charge collector foils 12 and 15 can also prevent damaging by the

oscillating burden accompanying ultrasonic welding.

[0008] Furthermore, since the end of the positive-electrode terminal 23 is inserted between one [to which the laminating of two or more positive-electrode charge collector foils 12 was carried out / all] edge 12b and the end of the negative-electrode terminal 21 is inserted among all other-end section 15a to which the laminating of two or more negative-electrode charge collector foils 15 was carried out Even if it repeats a rechargeable battery 10 and incurvates it, between the positive-electrode charge collector foils 12 the positive-electrode terminal 23 and whose positive-electrode terminal 23 of its are pinched Or a clearance is not generated between the negative-electrode charge collector foils 15 the negative-electrode terminal 21 and whose negative-electrode terminal 21 of its are pinched, and the conductivity in the contact part is secured and can fully reduce the resistance in a terminal joint.

[0009] Invention concerning claim 2 is a lithium ion polymer rechargeable battery the positive-electrode terminal 23 and whose negative-electrode terminal 21 it is invention concerning claim 1 and are an expanded metal or the punched metal sheet, respectively. In invention concerning this claim 2, when the flexibility of a terminal 21 and 23 the very thing secures, while securing the flexible nature of the sheet-like rechargeable battery 10 certainly, adhesion with a package 26 can be raised and the sealing performance of the rechargeable battery by that package 26 can be secured.

[0010] Invention concerning claim 3 is invention concerning claim 1 or 2. The construction material of the positive-electrode charge collector foil 12 The reinforcement foil or the reinforcement sheet metal 22 and 24 which is the same construction material as the construction material of the negative-electrode charge collector foil 15, has the thickness of 0.05-0.5mm, and has an area larger than the area of the ultrasonic welding per time Either [or] the positive-electrode charge collector foil 12 or the negative-electrode charge collector foil 15. Or it is the lithium ion polymer rechargeable battery by which has been arranged on the laminating outside surface of both edges, and ultrasonic welding was carried out through a reinforcement foil or reinforcement sheet metal 22 and 24. In invention concerning this claim 3, by arranging a reinforcement foil or reinforcement sheet metal 22 and 24, breakage of the crack in the welding part of the positive-electrode charge collector foil 12 in an outside and the negative-electrode charge collector foil 15 at the time of incurvating a rechargeable battery 10 etc. can be prevented, and the dependability of a rechargeable battery 10 can be raised.

[0011] A reinforcement foil or reinforcement sheet metal 22 and 24 may be arranged only on the laminating outside surface of the negative-electrode charge collector foil

[the positive-electrode charge collector foil 12 or / either / either] 15 of both edges, and may be arranged on the laminating outside surface of the both sides of the edge. However, to arrange a reinforcement foil or reinforcement sheet metal 22 and 24 only on one laminating outside surface of an edge, it is necessary to arrange on the laminating outside surface of the side in contact with the vibrator in ultrasonic welding equipment. It is because breakage of the edge in the positive-electrode charge collector foil 12 or the negative-electrode charge collector foil 15 resulting from contacting and vibrating to vibrator can be prevented with a reinforcement foil or reinforcement sheet metal 22 and 24. Here, when there is a possibility that reinforcement sheet metal may be destroyed at the time of welding as the thickness of reinforcement sheet metal 22 and 24 is less than 0.05mm and the thickness exceeds 0.5mm, there is a possibility that poor welding may occur. In addition, the still more desirable thickness of reinforcement sheet metal 22 and 24 is 0.1-0.3mm.

[0012] invention concerning claim 4 -- claim 1 thru/or 3 -- it is the lithium ion polymer rechargeable battery whose predetermined spacing t of ultrasonic welding it is invention concerning either, the area of the ultrasonic welding per time is 2 5-200mm, and is 1-10mm. In invention concerning this claim 4, while securing welding reinforcement by setting area of ultrasonic welding to 2 5-200mm, the flexible nature of the sheet-like rechargeable battery 10 is certainly securable by setting predetermined spacing to 1-10mm. Here, bonding strength with a as sufficient area of ultrasonic welding as being less than [5mm] two is not obtained, but when the area exceeds 2 200mm, there is a possibility that the positive-electrode charge collector foil 12 or the negative-electrode charge collector foil 15 may be damaged. In addition, a still more desirable area of the area of ultrasonic welding is 2 50-100mm. Moreover, when there is a possibility that the adjoining welding part already welded at the time of welding as the predetermined spacing t of ultrasonic welding is less than 1mm may be damaged and the spacing t exceeds 10mm, there is nonconformity to which cause reduction of a welding gross area to and the resistance in a welding part is made to increase. In addition, the still more desirable range of this spacing t is 3-7mm.

[0013] invention concerning claim 5 -- claim 1 thru/or 4 -- it is the lithium ion polymer rechargeable battery whose output of ultrasonic welding it is invention concerning either, the frequency of ultrasonic welding is 10-60kHz, and is 0.2-50kW. In invention concerning this claim 5, ultrasonic welding of the positive-electrode terminal 23 and the negative-electrode terminal 21 can be carried out to edge 12b and other-end section 15a by which the laminating was carried out on the most proper conditions, and while the laminating was carried out makes comparatively easy a fabrication of a lithium ion

polymer rechargeable battery. When there is nonconformity which produces poor welding as it is that the frequency of ultrasonic welding is less than 10kHz, or the output of ultrasonic welding is less than 0.2kW here, and the frequency of ultrasonic welding exceeds 60kHz or the output of ultrasonic welding exceeds 50kW, there is nonconformity which damages the vibrator in welding equipment. In addition, the still more desirable range of the frequency of ultrasonic welding is 20-40kHz, and the still more desirable range of the output of ultrasonic welding is 0.5-3kW.

[0014]

[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained in detail based on a drawing. As shown in drawing 2 and drawing 3 , the lithium ion polymer rechargeable battery 10 infixes the polymer electrolyte layer 17 between the positive-electrode sheet 11 and the negative-electrode sheet 14, and carries out the laminating of the positive-electrode sheet 11 and the negative-electrode sheet 14. Positive active material 13 is applied to the front face of the positive-electrode charge collector foil 12, and, as for the positive-electrode sheet 11, the negative-electrode active material 16 is applied to the front face of the negative-electrode charge collector foil 15, as for the negative-electrode sheet 14. Moreover, the polymer electrolyte layer 17 is infixed in the positive-electrode charge collector foil 12 between the negative-electrode active materials 16 by which spreading formation was carried out on the front face of the positive active material 13 by which spreading formation was carried out, and the negative-electrode charge collector foil 15. In order that this lithium ion polymer rechargeable battery 10 may expand discharge capacity, that band-like negative-electrode charge collector foil 15 is folded up by the front face of the negative-electrode active material 16 in the condition with the polymer electrolyte layer 17 using the band-like negative-electrode charge collector foil 15. In addition, the negative-electrode charge collector foil 15 in the gestalt of this operation is a Cu foil, and the active material of a graphite system is used for the negative-electrode active material 16.

[0015] As shown in drawing 7 (a) and (b), the concrete formation procedure to the front face of the negative-electrode charge collector foil 15 of the negative-electrode active material 16 is performed by applying to the top face of the band-like negative-electrode charge collector foil 15 the slurry which carried out distributed mixing and produced the active material in the solution with a doctor blade method, and drying. On the other hand, the negative-electrode active material 16 is formed in the top face of the negative-electrode charge collector foil 15 in drawing which is a front face except for flank 15b of another side, and the polymer electrolyte layer 17 is made by the top face of

the negative-electrode active material 16 by carrying out spreading desiccation of the electrolyte slurry. The polymer electrolyte layer 17 is formed so that it may have the area which covers this negative-electrode active material 16. As shown in drawing 7 (c), an electrolyte slurry is applied so that the negative-electrode active material 16 may be covered, and, specifically, it is formed in the area which covers the negative-electrode active material 16 by drying after that.

[0016] It returns to drawing 3 and two or more positive-electrode sheets 11 which have the area to which the lithium ion polymer rechargeable battery 10 ****ed in a fold-up area, respectively between the polymer electrolyte layers 17 except the fold of the folded-up negative-electrode sheet 14 are pinched. The positive-electrode charge collector foil 12 in the gestalt of this operation with which the polymer electrolyte layer 17 is formed also in the front face of the positive active material 13 of the positive-electrode sheet 11 pinched is an aluminum foil, and LiCoO2 is used for positive active material 13.

[0017] The concrete production procedure of the positive-electrode sheet 11 forms positive active material 13 in the top face of the band-like aluminum foil 18 which turns into a positive-electrode charge collector foil behind first by applying the slurry which carried out distributed mixing of the active material at the solution with a doctor blade method, and drying, as shown in drawing 6 R> 6 (a) and (b). Positive active material 13 is formed except for one flank of the aluminum foil 18, and the polymer electrolyte layer 17 is formed so that it may have the area which covers this positive active material 13. As shown in drawing 6 (c), an electrolyte slurry is applied so that positive active material 13 may be covered, and, specifically, is formed in the area which covers positive active material 13 by drying after that. As shown in drawing 6 (d) after that, the band-like aluminum foil 18 which has positive active material 13 and the polymer electrolyte layer 17 is cut so that it may have the area which ****ed in the folding area of the negative-electrode sheet 14 with the positive active material 13 and the polymer electrolyte layer 17. Thereby, positive active material 13 is formed in the front face of the positive-electrode charge collector foil 12, and two or more positive-electrode sheets 11 of a predetermined area which has the polymer electrolyte layer 17 on the positive-active-material 13 front face are made.

[0018] Subsequently, as shown in drawing 5 , the polymer electrolyte layer 17 is infixed in between, and the laminating of the positive-electrode sheet 11 and the negative-electrode sheet 14 is carried out. This laminating is performed by thermocompression bonding. That is, arrange two or more positive-electrode sheets 11 in the predetermined pitch which ****s at spacing of a fold on the negative-electrode

sheet 14, and it is made to pass, as shown in the continuous-line arrow head of drawing between the roller 19 of a couple which rotates to the opposite direction heated by temperature predetermined in the condition, respectively, and 19, and where the polymer electrolyte layer 17 is infixed, thermocompression bonding of the positive-electrode sheet 11 and the negative-electrode sheet 14 is carried out. Arrangement of a up to [the negative-electrode sheet 14 of two or more positive-electrode sheets 11] One edge 12b of two or more positive-electrode charge collector foils 12 From one edge 15b of the band-like negative-electrode charge collector foil 15 to a projection From other-end section 12a of two or more positive-electrode charge collector foils 12, other-end section 15a of the band-like negative-electrode charge collector foil 15 opens a projection and the part in which each positive-electrode sheet 11 is equivalent to the fold of the negative-electrode sheet 14, and is arranged so that it may carry out.

[0019] As shown in drawing 4 , folding of the negative-electrode sheet 14 with which the laminating of the positive-electrode sheet 11 was carried out in this way is performed by bending by turns the fold of the negative-electrode sheet 14 with which the positive-electrode sheet 11 is not arranged. Thus, if it folds up, after one edge 12b of two or more positive-electrode charge collector foils 12 has projected from other-end section 12a of two or more positive-electrode charge collector foils 12, the laminating of the other-end section 15a of the projection from one edge 15b of the band-like negative-electrode charge collector foil 15 and the band-like negative-electrode charge collector foil 15 will be carried out. As shown in drawing 3 , between the polymer electrolyte layers 17 except the fold of the negative-electrode sheet 14 folded up in this way, two or more positive-electrode sheets 11 which have the area which ****ed in a fold-up area, respectively are pinched. And the end of the sheet-like positive-electrode terminal 23 is connected to one [all] edge 12b of two or more positive-electrode charge collector foils 12 which project from one edge 15b of the negative-electrode charge collector foil 15, and the end of the sheet-like negative-electrode terminal 21 is connected to all other-end section 15a of two or more negative-electrode charge collector foils 15 which project from other-end section 12a of the positive-electrode charge collector foil 12. The expanded metal which has flexibility, respectively, or the punched metal sheet is used for the positive-electrode terminal 23 and the negative-electrode terminal 21 in a gestalt of this operation.

[0020] As shown in drawing 1 , drawing 2 , and drawing 4 , the laminating of one [all] edge 12b of two or more positive-electrode charge collector foils 12 is carried out, and the end of the positive-electrode terminal 23 is inserted between one [to which the

laminating of two or more positive-electrode charge collector foils 12 was carried out / all] edge 12b. And where the end of the positive-electrode terminal 23 is inserted, the predetermined spacing t (drawing 1) is opened in the direction which intersects the path of insertion, two or more place ultrasonic welding is made, and the end of the positive-electrode terminal 23 is connected to one [all] edge 12b of two or more positive-electrode charge collector foils 12. It is arranged on the laminating outside surface of edge 12b, respectively, and ultrasonic welding is made for while the laminating of the positive-electrode charge collector foil 12 was carried out for the reinforcement foil or the reinforcement sheet metal 24 whose thickness it is thin on the occasion of this ultrasonic welding from aluminum which is the same construction material as the construction material of the positive-electrode charge collector foil 12 is 0.05-0.5mm through that reinforcement foil or reinforcement sheet metal 24.

[0021] On the other hand, the laminating of all the other-end section 15a of two or more negative-electrode charge collector foils 15 is carried out, and the end of the negative-electrode terminal 21 is inserted among all other-end section 15a to which the laminating of two or more negative-electrode charge collector foils 15 was carried out. And the end of a negative-electrode terminal is connected to all other-end section 15a of two or more negative-electrode charge collector foils 15 by opening and carrying out two or more place ultrasonic welding of the predetermined spacing t (drawing 1) in the direction which intersects the path of insertion in the state of insertion of the negative-electrode terminal 21. On the occasion of this ultrasonic welding, the reinforcement foil or the reinforcement sheet metal 22 whose thickness it is Cu which is the same construction material as the construction material of the negative-electrode charge collector foil 15, and is 0.05-0.5mm is arranged, respectively on the laminating outside surface of all the other-end sections on which the laminating of the negative-electrode charge collector foil 15 was carried out, and ultrasonic welding is made through a reinforcement foil or reinforcement sheet metal 22.

[0022] The ultrasonic welding in the gestalt of this operation is within the limits that frequency of whose is 10-60kHz, the output of ultrasonic welding is performed within the limits of 0.2-50kW, and it is adjusted so that the area of the ultrasonic welding per time may be set to 2 5-200mm. And predetermined spacing of ultrasonic welding is adjusted within the limits of 1-10mm. The reinforcement foil or the reinforcement sheet metal 22 and 24 arranged on a laminating outside surface in the case of ultrasonic welding is made so that it may have an area larger than the area of the ultrasonic welding per time, and it is made for a superfluous load not to join each of the positive-electrode charge collector foil 12 at the time of welding, and the

negative-electrode charge collector foil 15.

[0023] As shown in drawing 2 and drawing 3 , the band-like negative-electrode sheet 14 folded up in this way is sealed with the package sheet 26 with two or more positive-electrode sheets 14. The aluminium foil with which denaturation polypropylene laminated the package sheet 26 in the gestalt of this operation is used. The band-like negative-electrode sheet 14 folded up with the package sheet 26 of a couple as the laminated denaturation polypropylene was made to counter is inserted with two or more positive-electrode sheets 11, and the band-like negative-electrode sheet 14 with which denaturation polypropylene made it mutual thermal melting arrival, and was folded up is sealed with the package sheet 26 with two or more positive-electrode sheets 14 by carrying out thermocompression bonding of the perimeter of the package sheet 26 piled up in the vacuum ambient atmosphere.

[0024] In the case of seal, the positive-electrode terminal 23 and the negative-electrode terminal 21 of the package sheet 26 of a couple are pinched so that the other end of the positive-electrode terminal 23 and the other end of the negative-electrode terminal 21 may express to the exterior of the package sheet 26, respectively, and thermocompression bonding of the perimeter of the package sheet 26 of a couple is carried out in the condition. With the gestalt of this operation, since the positive-electrode terminal 23 and the negative-electrode terminal 21 are formed with the expanded metal or the punched metal sheet, respectively If thermocompression bonding of the perimeter of the package sheet 26 is carried out, will carry out the thermal melting solution of the denaturation polypropylene laminated in aluminium foil, and it will trespass upon punching of the stitch of an expanded metal, or a metal sheet. Since denaturation polypropylene hardens after that, the adhesion of a package 26, the positive-electrode terminal 23, and the negative-electrode terminal 21 is secured, and seal of the rechargeable battery by the package 26 is ensured.

[0025] Thus, in the constituted lithium ion polymer rechargeable battery 10, the desired electrical and electric equipment can be obtained by using the other end of the positive electrode pulled out from the package sheet 26, and the negative-electrode terminals 21 and 23 as a terminal of a cell. Although the laminating of one [all] edge 12b of two or more positive-electrode charge collector foils 12 and all the other-end section 15a of two or more negative-electrode charge collector foils 15 is carried out, respectively and the positive-electrode terminal 23 and the negative-electrode terminal 21 are connected here Since the connection is made by opening and carrying out two or more place ultrasonic welding of the predetermined spacing t Lifting of a mechanical strength can be controlled as compared with the case where all the parts of the edge by which the

laminating was carried out are joined, and the flexible nature which the sheet-like rechargeable battery 10 has from the former can be secured.

[0026] Moreover, since the end of the positive-electrode terminal 23 is inserted between one [to which the laminating of two or more positive-electrode charge collector foils 12 was carried out / all] edge 12b and the end of the negative-electrode terminal 21 is inserted among all other-end section 15a to which the laminating of two or more negative-electrode charge collector foils 15 was carried out Even if it repeats a rechargeable battery 10 and incurvates it, between the positive-electrode charge collector foils 12 the positive-electrode terminal 23 and whose positive-electrode terminal 23 of its are pinched Or a clearance is not generated between the negative-electrode charge collector foils 15 the negative-electrode terminal 21 and whose negative-electrode terminal 21 of its are pinched, and the conductivity in the contact part is secured and can fully reduce the resistance in a terminal joint.

[0027] Furthermore, on the occasion of ultrasonic welding, the laminating of the positive-electrode charge collector foil 12 was carried out for while, and a reinforcement foil or reinforcement sheet metal 24 is arranged on the laminating outside surface of edge 12b. Since a reinforcement foil or reinforcement sheet metal 22 has been arranged on the laminating outside surface of other-end section 15a on which the laminating of the negative-electrode charge collector foil 15 was carried out Breakage of the crack in the welding part of the positive-electrode charge collector foil 12 in an outside and the negative-electrode charge collector foil 15 at the time of incurvating a rechargeable battery 10 etc. can be prevented, and the dependability of a rechargeable battery 10 can be raised.

[0028] In addition, although the band-like negative-electrode sheet 14 with which thermocompression bonding of two or more positive-electrode sheets 11 in a predetermined pitch was carried out was bent by turns in the gestalt of operation mentioned above with the fold by which the positive-electrode sheet 11 is not arranged The laminating of two or more same positive-electrodes charge collector foil as a positive-electrode sheet in which number-prepare, a polymer electrolyte layer is made to intervene between positive active material and a negative-electrode active material, respectively, and those sheets are constituted, and two or more negative-electrode charge collector foils may be carried out for a positive-electrode sheet and two or more negative-electrode sheets of isomorphous ** size.

[0029]

[Example] Next, the example of this invention is explained.

<Example 1> The positive-electrode sheet 11 of two or more sheets was produced first.

That is, distributed mixing of 70g of LiCoO2 powder and the 4g (trade name; KETCHIEN black) of the graphite powder was carried out at N-methyl pyrrolidone solution of polyvinylidene fluoride, and the slurry was produced. On the other hand, 40g (the Elf Atochem make, Kynar2810; hexafluoropropylene 12wt% content article) of vinylidene fluoride-hexafluoropropylene copolymers was dissolved in dimethyl carbonate 200g at 60 degrees C, churning mixing of the 80g of the electrolytic solutions was carried out further, and the electrolyte slurry was produced. Next, the slurry which carried out distributed mixing of the active material was applied and dried with the doctor blade method on the top face of aluminum foil whose width-of-face die length of 10cm is 1m, and the electrolyte slurry was applied and dried so that the positive active material 13 might be covered further. Band-like aluminum foil with which it dried and positive active material 13 and the polymer electrolyte layer 17 were formed was cut with the positive active material 13 and the polymer electrolyte layer 17, and width of face obtained the positive-electrode sheet 11 which is ten sheets whose 10cm die length is 10cm.

[0030] Next, the band-like negative-electrode sheet 14 was produced. That is, after width-of-face die length of 10cm applied and dried the slurry which carried out distributed mixing of the 50g of the piece of phosphorus-like natural-graphite powder at N-methyl pyrrolidone solution of polyvinylidene fluoride with the doctor blade method on the top face of Cu foil which is 1m, the electrolyte slurry mentioned above was applied and dried so that the positive active material 13 might be covered further, and the band-like negative-electrode sheet 14 was produced. Thermocompression bonding of two or more positive-electrode sheets 11 in the predetermined pitch which ****s at spacing of a fold was carried out to this band-like negative-electrode sheet 14, and the layered product by which the with a width-of-face die length [10cm die length of 10cm] positive-electrode sheet 11 of ten sheets was pinched [in the fold of the negative-electrode sheet 14 with which the positive-electrode sheet 11 is not arranged], respectively between the polymer electrolyte layers 17 of the band-like negative-electrode sheet 14 which has folding and with a width-of-face die length [10cm die length of 10cm] folding area by turns was obtained.

[0031] The laminating of one [all] edge 12b of two or more positive-electrode charge collector foils 12 which project from one edge 15b of the negative-electrode charge collector foil 15 of this layered product is carried out. It inserts between edge 12b. the end of the positive-electrode terminal 23 of the shape of a sheet which consists of an expanded metal knit with the copper wire with a thickness of 0.1mm by which nickel plating was carried out -- the -- the laminating of while having been carried out and The

end of the positive-electrode terminal 23 was connected to one [all] edge 12b of two or more positive-electrode charge collector foils 12 by opening and carrying out five-place ultrasonic welding of the spacing of 5mm in the direction which intersects the path of insertion in the state of insertion. Moreover, the laminating of all the other-end section 15a of two or more negative-electrode charge collector foils 15 which project from other-end section 12a of the forward negative-electrode charge collector foil 12 of a layered product is carried out. The end of the negative-electrode terminal 21 of the shape of a sheet which consists of an expanded metal knit with the copper wire with a thickness of 0.1mm by which nickel plating was carried out is inserted between the other-end section 15a by which the laminating was carried out. The end of the negative-electrode terminal 21 was connected to one [all] edge 15a of two or more negative-electrode charge collector foils 15 by opening and carrying out five-place ultrasonic welding of the spacing of 5mm in the direction which intersects the path of insertion in the state of insertion. It sealed with a package 26 and the lithium ion polymer rechargeable battery was obtained so that the other end of the positive-electrode terminal 23 and the other end of the negative-electrode terminal 21 might be expressed after that. This cell was made into the example 1.

[0032] The same layered product as an example 1 was obtained in the same procedure as the <example 1 of comparison> example 1. The laminating of one [all] edge 12b of two or more positive-electrode charge collector foils 12 which project from one edge 15b of the negative-electrode charge collector foil 15 of this layered product is carried out. Edge 12b is inserted. the positive-electrode terminal of the couple of the shape of a sheet which consists of the same expanded metal as an example 1 -- the -- while the laminating was carried out with the positive-electrode terminal of a couple in the condition The end of the positive-electrode terminal 23 was connected to one [all] edge 12b of two or more positive-electrode charge collector foils 12 by opening and carrying out two-place ultrasonic welding of the spacing of 50mm. Moreover, the laminating of all the other-end section 15a of two or more negative-electrode charge collector foils 15 which project from other-end section 12a of the forward negative-electrode charge collector foil 12 of a layered product is carried out. Edge 12b is inserted. the negative-electrode terminal of the couple of the shape of a sheet which consists of the same expanded metal as an example 1 -- the -- while the laminating was carried out with the negative-electrode terminal of a couple in the condition The end of the negative-electrode terminal 21 was connected to one [all] edge 15a of two or more negative-electrode charge collector foils 15 by opening and carrying out two-place ultrasonic welding of the spacing of 50mm. It sealed with a package 26 and the lithium

ion polymer rechargeable battery was obtained so that the other end of the positive-electrode terminal 23 and the other end of the negative-electrode terminal 21 might express after that. This cell was made into the example 1 of a comparison.

[0033] After incurvating the lithium ion polymer rechargeable battery of the <comparative study> example 1 and the example 1 of a comparison until it becomes the radius of curvature of 15cm, making it curve until it becomes the radius of curvature of 15cm to hard flow after that, and repeating this 10 times, it was made to discharge by 3A, respectively. The ratio to the capacity at the time of the 0.5A discharge at this time was measured. Consequently, although 80% of discharge capacity was secured in the example 1, it was 30% in the example 1 of a comparison.

[0034] In the example 1 of a <assessment> comparison, it turns out that discharge capacity is falling as compared with an example 1. Since it is arranged and this is welded so that it may face across the edge of the positive-electrode charge collector foil with which the laminating of the terminal in the example 1 of a comparison was carried out, and a negative-electrode charge collector foil, a clearance is generated between the edge of charge collector foils other than the part welded to having incurvated the cell by originating, and a terminal, and it is thought that it originates in the conductivity in the part having been lost. On the other hand, in the example 1, it turns out that discharge capacity is high as compared with the example 1 of a comparison. Since the terminal in an example 1 is inserted between the edges of the bundled positive-electrode charge collector foil by which the laminating was carried out, and a negative-electrode charge collector foil and this is welded in the state of insertion, even if it incurvates a cell, it is thought that it originates in a clearance not being generated between the edge of a charge collector foil and a terminal, and the conductivity between the edge of a charge collector foil and a terminal fully being secured.

[0035]

[Effect of the Invention] As stated above, according to this invention, the laminating of one [all] edge of two or more positive-electrode charge collector foils and all the other-end sections of two or more negative-electrode charge collector foils is carried out, respectively. The end of a positive-electrode terminal is connected to the edge of two or more positive-electrode charge collector foils by opening and carrying out two or more place ultrasonic welding of the predetermined spacing. Since the end of a negative-electrode terminal was connected to the other-end section of two or more negative-electrode charge collector foils by opening and carrying out two or more place ultrasonic welding of the predetermined spacing Lifting of a mechanical strength can be controlled as compared with the case where all the parts of the edge by which the

laminating was carried out are joined, and the flexible nature which a sheet-like rechargeable battery has from the former can be secured. Moreover, since the end of a positive-electrode terminal was inserted between one [all] edges where the laminating of two or more positive-electrode charge collector foils was carried out and the end of a negative-electrode terminal was inserted among all the other-end sections to which the laminating of two or more negative-electrode charge collector foils was carried out Even if it repeats a rechargeable battery and incurvates it, between the positive-electrode charge collector foils a positive-electrode terminal and whose positive-electrode terminal of its are pinched Or a clearance is not generated between the negative-electrode charge collector foils a negative-electrode terminal and whose negative-electrode terminal of its are pinched, and the conductivity in the contact part is secured and can fully reduce the resistance in a terminal joint.

[0036] Moreover, if a positive-electrode terminal and a negative-electrode terminal are carried out and an expanded metal or the punched metal sheet is used, respectively If the flexibility of the terminal itself can be secured, the flexible nature of a sheet-like rechargeable battery can be secured certainly and a reinforcement foil or reinforcement sheet metal is arranged on the laminating outside surface of both edges of a negative-electrode charge collector foil [a positive-electrode charge collector foil or / either / either / all] Breakage of the crack in the welding part of the positive-electrode charge collector foil in an outside and negative-electrode charge collector foil at the time of incurvating a rechargeable battery etc. can be prevented, and the dependability of a rechargeable battery can also be raised.

[Brief Description of the Drawings]

[Drawing 1] The perspective view showing the rechargeable battery of this invention.

[Drawing 2] The B-B line sectional view of drawing 3 showing the rechargeable battery.

[Drawing 3] The A-A line sectional view of drawing 2 showing the rechargeable battery.

[Drawing 4] The decomposition perspective view showing the configuration of the rechargeable battery.

[Drawing 5] The perspective view showing the condition that thermocompression bonding of the positive-electrode sheet is carried out to the negative-electrode sheet.

[Drawing 6] Drawing showing the production process of the positive-electrode sheet.

[Drawing 7] Drawing showing the production process of the negative-electrode sheet.

[Description of Notations]

10 Lithium Ion Polymer Rechargeable Battery

12 Positive-Electrode Charge Collector Foil

12a Other-end section

12b One edge
13 Positive Active Material
15 Negative-Electrode Charge Collector Foil
15a Other-end section
15b One edge
16 Negative-Electrode Active Material
17 Polymer Electrolyte Layer
21 Negative-Electrode Terminal
22 Reinforcement Foil or Reinforcement Sheet Metal
23 Positive-Electrode Terminal
24 Reinforcement Foil or Reinforcement Sheet Metal
t Predetermined spacing

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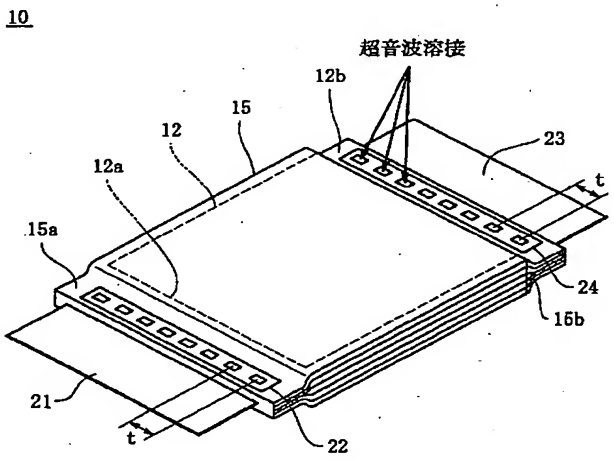
最終頁に続く

(54)【発明の名称】　リチウムイオンポリマー二次電池

(57)【要約】
【課題】　フレキシブル性を確保しつつ端子接合部における抵抗を低減する。
【解決手段】複数の正極集電体箔１２と複数の負極集電体箔１５とがポリマー電解質層１７を介して積層され、複数の正極集電体箔の一方の端部１２ｂ及び複数の負極集電体箔１５の他方の端部１５ａがそれぞれ積層され、正極端子２３の一端が複数の正極集電体箔の積層された全ての一方の端部の間に挿入されかつ挿入状態で挿入方向と交差する方向に所定の間隔ｔをあけて複数個所超音波溶接することにより正極端子２３の一端が複数の正極集電体箔１２の全ての一方の端部１２ｂに接続され、負極端子２１の一端が複数の負極集電体箔の積層された全ての他方の端部１５ａの間に挿入されかつ挿入状態で挿入方向と交差する方向に所定の間隔ｔをあけて複数個所超音波溶接することにより負極端子２１の一端が複数の負極集電体箔１５の全ての他方の端部１５ａに接続される。



10　リチウムイオンポリマー二次電池
12　正極集電体箔
12b　一方の端部
15　負極集電体箔
15a　他方の端部
21　負極端子
23　正極端子
t　所定の間隔

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【特許請求の範囲】

【請求項１】　複数の正極集電体箔(12)の各表面に正極活物質(13)が塗布され、複数の負極集電体箔(15)の各表面に負極活物質(16)が塗布され、前記複数の正極集電体箔(12)と前記複数の負極集電体箔(15)とが前記正極活物質(13)と前記負極活物質(16)との間にそれぞれポリマー電解質層(17)を介して積層され、前記負極集電体箔(15)の一方の端部(15b)から突出する前記複数の正極集電体箔(12)の全ての一方の端部(12b)にシート状の正極端子(23)の一端が接続され、前記正極集電体箔(12)の他方の端部(12a)から突出する前記複数の負極集電体箔(15)の全ての他方の端部(15a)にシート状の負極端子(21)の一端が接続され、前記正極端子(23)の他端及び前記負極端子(21)の他端を表出するように前記正極集電体箔(12)と前記負極集電体箔(15)との積層体がパッケージ(26)により密閉されたリチウムイオンポリマー二次電池において、

前記複数の正極集電体箔(12)の全ての一方の端部(12b)及び前記複数の負極集電体箔(15)の全ての他方の端部(15a)がそれぞれ積層され、

前記正極端子(23)の一端が前記複数の正極集電体箔(12)の積層された全ての一方の端部(12b)の間に挿入されかつ挿入状態で挿入方向と交差する方向に所定の間隔(t)をあけて複数個所超音波溶接することにより前記正極端子(23)の一端が前記複数の正極集電体箔(12)の全ての一方の端部(12b)に接続され、

前記負極端子(21)の一端が前記複数の負極集電体箔(15)の積層された全ての他方の端部(15a)の間に挿入されかつ挿入状態で挿入方向と交差する方向に所定の間隔(t)をあけて複数個所超音波溶接することにより前記負極端子(21)の一端が前記複数の負極集電体箔(15)の全ての他方の端部(15a)に接続されたことを特徴とするリチウムイオンポリマー二次電池。

【請求項２】　正極端子(23)及び負極端子(21)がそれぞれエキスパンデッドメタル又は穿孔された金属シートである請求項１記載のリチウムイオンポリマー二次電池。

【請求項３】　正極集電体箔(12)の材質又は負極集電体箔(15)の材質と同一材質であって０．０５～０．５mmの厚さを有しかつ１回当たりの超音波溶接の面積より広い面積を有する補強箔又は補強薄板(22, 24)が正極集電体箔(12)又は負極集電体箔(15)のいずれか一方又は双方の端部の積層外面に配置され、前記補強箔又は補強薄板(22, 24)を介して超音波溶接された請求項１又は２記載のリチウムイオンポリマー二次電池。

【請求項４】　１回当たりの超音波溶接の面積が５～２００mm^{2}であり、超音波溶接の所定の間隔が１～１０mmである請求項１ないし３いずれか記載のリチウムイオンポリマー二次電池。

【請求項５】　超音波溶接の周波数が１０～６０ｋＨｚであり、超音波溶接の出力が０．２～５０ｋＷである請求項１ないし４いずれか記載のリチウムイオンポリマー二次電池。

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【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ポリマー電解質層を介して正極活物質と負極活物質を積層したリチウムイオンポリマー二次電池に関するものである。

【０００２】

【従来の技術】従来、ビデオカメラやノート型パソコン等のポータブル機器の普及によって薄くてある程度フレキシブルな電池に対する需要が高まっている。この薄型の電池として、正極シートと負極シートを積層して形成されたリチウムイオンポリマー二次電池が知られている。この正極シートは、正極集電体箔の表面に活物質を塗布することにより作られ、負極シートは負極集電体箔の表面に活物質を塗布することにより作られる。正極シートの活物質と負極シートの活物質の間にはポリマー電解質層が介装される。この電池では、それぞれの活物質における電位差を電流として取出すための正極端子及び負極端子が正極集電体箔及び負極集電体箔に設けられ、このように積層された積層体をパッケージで密閉することによりリチウムイオンポリマー二次電池が作成される。このリチウムイオンポリマー二次電池ではパッケージから引出された正極端子及び負極端子を電池の端子として使用することにより所望の電気が得られるようになっている。

【０００３】また、近年ではリチウムイオンポリマー二次電池の放電容量を増大させる傾向にあり、複数枚の正極シート及び複数枚の負極シートを用いて積層し、その放電容量を増大させたり、単一の正極シート及び単一の負極シートの面積を拡大させ、拡大した正極シート及び負極シートを所望の大きさに折畳むことによりその放電容量を拡大している。一方、正極シート及び負極シートを複数枚用いるか或いは折り畳んで放電容量を拡大することに伴い、層状に引き出された複数枚の正極集電体箔及び負極集電体箔の端部を互いに接続させて正極端子及び負極端子を接続することが必要である。この接続手段として、層状に引き出された複数枚の正極集電体箔及び負極集電体箔の端部を分離して束ね、端子を兼ねる導電体でこの束ねた端部を挟み、束ねられた端部と導電体を溶接してその導電体を通じて電気を取り出すようにした二次電池が提案されている（特開平７－２６３０２９）。

【０００４】

【発明が解決しようとする課題】しかし、束ねられた正極集電体箔又は負極集電体箔の全ての端部と導電体とを溶接によって接合したときには、その接合部分における機械的強度が溶接により高まり、電池のフレキシブル性が失われる不具合がある。特に棒状の金属片からなる導電体を用いた場合にはその接合部分における可撓性か完

全に失われる欠点がある。逆に、比較的可撓性を有する導電体で挟み、その導電体と束ねられた端部を部分的に溶接したときには、電池のフレキシブル性を保つことはできるけれども、電池を湾曲させることにより溶接された部分以外の端部と外側から挟んだ導電体との間に隙間が生じ、その部分における導電性が失われ、結果として抵抗値が増加して十分な電力を得られない問題がある。本発明の目的は、フレキシブル性を確保しつつ端子接合部における抵抗を低減し得るリチウムイオンポリマー二次電池を提供することにある。

【０００５】

【課題を解決するための手段】請求項１に係る発明は、図１及び図２に示すように、複数の正極集電体箔１２の各表面に正極活物質１３が塗布され、複数の負極集電体箔１５の各表面に負極活物質１６が塗布され、複数の正極集電体箔１２と複数の負極集電体箔１５とが正極活物質１３と負極活物質１６との間にそれぞれポリマー電解質層１７を介して積層され、負極集電体箔１５の一方の端部１５ｂから突出する複数の正極集電体箔１２の全ての一方の端部１２ｂにシート状の正極端子２３の一端が接続され、正極集電体箔１２の他方の端部１２ａから突出する複数の負極集電体箔１５の全ての他方の端部１５ａにシート状の負極端子２１の一端が接続され、正極端子２３の他端及び負極端子２１の他端を表出するように正極集電体箔１２と負極集電体箔１５との積層体がパッケージ２６により密閉されたリチウムイオンポリマー二次電池の改良である。

【０００６】その特徴ある構成は、複数の正極集電体箔１２の全ての一方の端部１２ｂ及び複数の負極集電体箔１５の全ての他方の端部１５ａがそれぞれ積層され、正極端子２３の一端が複数の正極集電体箔１２の積層された全ての一方の端部１２ｂの間に挿入されかつ挿入状態で挿入方向と交差する方向に所定の間隔ｔをあけて複数個所超音波溶接することにより正極端子２３の一端が複数の正極集電体箔１２の全ての一方の端部１２ｂに接続され、負極端子２１の一端が複数の負極集電体箔１５の積層された全ての他方の端部１５ａの間に挿入されかつ挿入状態で挿入方向と交差する方向に所定の間隔ｔをあけて複数個所超音波溶接することにより負極端子２１の一端が複数の負極集電体箔１５の全ての他方の端部１５ａに接続されたところにある。

【０００７】この請求項１に係る発明では、複数の正極集電体箔１２の全ての一方の端部１２ｂ及び複数の負極集電体箔１５の全ての他方の端部１５ａをそれぞれ積層して、正極端子２３及び負極端子２１を接続するが、その接続は、所定の間隔ｔをあけて複数個所超音波溶接することにより行われるので、積層された端部１２ａ，１５ｂの全ての部分を接合する場合に比較して機械的強度の上昇を抑制することができ、シート状の二次電池１０が従来から有するフレキシブル性を確保することができる。また、積層された端部１２ａ，１５ｂの全ての部分を超音波溶接すると、正極及び負極集電体箔１２，１５に過剰な振動負担が加わり、正極及び負極集電体箔１２，１５がその振動負担により破損するおそれがあるが、所定の間隔ｔをあけて複数個所超音波溶接することによりその振動負担は分散して減少するので、正極及び負極集電体箔１２，１５が超音波溶接に伴う振動負担により破損することを防止することもできる。

【０００８】更に、正極端子２３の一端は複数の正極集電体箔１２の積層された全ての一方の端部１２ｂの間に挿入され、負極端子２１の一端は複数の負極集電体箔１５の積層された全ての他方の端部１５ａの間に挿入されるので、二次電池１０を繰り返し湾曲させても、正極端子２３とその正極端子２３を挟む正極集電体箔１２の間に、又は負極端子２１とその負極端子２１を挟む負極集電体箔１５の間に隙間が生じることはなく、その接触部分における導電性は確保され、端子接合部における抵抗を十分に低減することができる。

【０００９】請求項２に係る発明は、請求項１に係る発明であって、正極端子２３及び負極端子２１がそれぞれエキスパンデッドメタル又は穿孔された金属シートであるリチウムイオンポリマー二次電池である。この請求項２に係る発明では、端子２１，２３自体の可撓性が確保することによりシート状の二次電池１０のフレキシブル性を確実に確保するとともに、パッケージ２６との密着性を向上させてそのパッケージ２６による二次電池の密封性を確保することができる。

【００１０】請求項３に係る発明は、請求項１又は２に係る発明であって、正極集電体箔１２の材質又は負極集電体箔１５の材質と同一材質であって０．０５～０．５ｍｍの厚さを有しかつ１回当たりの超音波溶接の面積より広い面積を有する補強箔又は補強薄板２２，２４が正極集電体箔１２又は負極集電体箔１５のいずれか一方又は双方の端部の積層外面に配置され、補強箔又は補強薄板２２，２４を介して超音波溶接されたリチウムイオンポリマー二次電池である。この請求項３に係る発明では、補強箔又は補強薄板２２，２４を配置することにより、二次電池１０を湾曲させた場合の、外側における正極集電体箔１２及び負極集電体箔１５の溶接箇所における亀裂等の破損を防止でき、二次電池１０の信頼性を向上させることができる。

【００１１】補強箔又は補強薄板２２，２４は、正極集電体箔１２又は負極集電体箔１５のいずれか一方又は双方の端部の一方の積層外面にのみ配置しても良く、その端部の双方の積層外面に配置しても良い。但し、端部の一方の積層外面にのみ補強箔又は補強薄板２２，２４を配置する場合には、超音波溶接装置における振動子に接触する側の積層外面に配置する必要がある。振動子に接触して振動することに起因する正極集電体箔１２又は負極集電体箔１５における端部の破損を補強箔又は補強薄

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板２２，２４により防止できるからである。ここで、補強薄板２２，２４の厚さが０．０５mm未満であると溶接時に補強薄板が破壊されるおそれがあり、その厚さが０．５mmを越えると溶接不良が発生するおそれがある。なお、補強薄板２２，２４の更に好ましい厚さは０．１～０．３mmである。

【００１２】請求項４に係る発明は、請求項１ないし３いずれかに係る発明であって、１回当たりの超音波溶接の面積が５～２００mm²であり、超音波溶接の所定の間隔ｔが１～１０mmであるリチウムイオンポリマー二次電池である。この請求項４に係る発明では、超音波溶接の面積を５～２００mm²とすることにより溶接強度を確保するとともに、所定の間隔を１～１０mmとすることによりシート状の二次電池１０のフレキシブル性を確実に確保することができる。ここで、超音波溶接の面積が５mm²未満であると十分な接合強度が得られず、その面積が２００mm²を越えると正極集電体箔１２又は負極集電体箔１５が破損するおそれがある。なお、超音波溶接の面積の更に好ましい面積は５０～１００mm²である。また、超音波溶接の所定の間隔ｔが１mm未満であると溶接時に既に溶接された隣接する溶接箇所が破損するおそれがあり、その間隔ｔが１０mmを越えると溶接総面積の減少を来して溶接箇所における抵抗値を増加させる不具合がある。なお、この間隔ｔの更に好ましい範囲は３～７mmである。

【００１３】請求項５に係る発明は、請求項１ないし４いずれかに係る発明であって、超音波溶接の周波数が１０～６０ｋＨｚであり、超音波溶接の出力が０．２～５０ｋＷであるリチウムイオンポリマー二次電池である。この請求項５に係る発明では、積層された一方の端部１２ｂ及び積層された他方の端部１５ａに、最も適正な条件で正極端子２３及び負極端子２１を超音波溶着させることができ、リチウムイオンポリマー二次電池の製作を比較的容易にする。ここで、超音波溶接の周波数が１０ｋＨｚ未満であるか又は超音波溶接の出力が０．２ｋＷ未満であるとであると溶接不良を生じさせる不具合があり、超音波溶接の周波数が６０ｋＨｚを越えるか又は超音波溶接の出力が５０ｋＷを越えると溶接装置における振動子を破損させる不具合がある。なお、超音波溶接の周波数の更に好ましい範囲は２０～４０ｋＨｚであり、超音波溶接の出力の更に好ましい範囲は０．５～３ｋＷである。

【００１４】

【発明の実施の形態】次に本発明の実施の形態を図面に基づいて詳しく説明する。図２及び図３に示すように、リチウムイオンポリマー二次電池１０は、正極シート１１と負極シート１４との間にポリマー電解質層１７を介装し、その正極シート１１及び負極シート１４を積層したものである。正極シート１１は正極集電体箔１２の表面に正極活物質１３が塗布されたものであり、負極シート１４は負極集電体箔１５の表面に負極活物質１６が塗布されたものである。また、ポリマー電解質層１７は正極集電体箔１２に塗布形成された正極活物質１３と負極集電体箔１５の表面に塗布形成された負極活物質１６との間に介装される。このリチウムイオンポリマー二次電池１０は、放電容量を拡大するために帯状の負極集電体箔１５を用い、その帯状の負極集電体箔１５は負極活物質１６の表面にポリマー電解質層１７を有した状態で折畳まれる。なお、この実施の形態における負極集電体箔１５はＣｕ箔であり、負極活物質１６にはグラファイト系の活物質が使用される。

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【００１５】図７（ａ）及び（ｂ）に示すように、負極活物質１６の負極集電体箔１５の表面への具体的な形成手順は、活物質を溶液に分散混合して作製したスラリーを帯状の負極集電体箔１５の上面にドクターブレード法により塗布して乾燥することにより行われる。一方、負極活物質１６は他方の側部１５ｂを除いて表面である図における負極集電体箔１５の上面に形成され、ポリマー電解質層１７はその負極活物質１６の上面に電解質スラリーを塗布乾燥することにより作られる。ポリマー電解質層１７はこの負極活物質１６を被覆する面積を有するように形成される。具体的には、図７（ｃ）に示すように、電解質スラリーを負極活物質１６を覆うように塗布し、その後乾燥することにより負極活物質１６を被覆する面積に形成される。

【００１６】図３に戻って、リチウムイオンポリマー二次電池１０は、折畳まれた負極シート１４の折目を除くポリマー電解質層１７の間にそれぞれ折畳み面積に相応した面積を有する複数の正極シート１１が挟持される。挟持される正極シート１１の正極活物質１３の表面にもポリマー電解質層１７が形成される、この実施の形態における正極集電体箔１２はＡｌ箔であり、正極活物質１３には例えば$LiCoO_2$が使用される。

【００１７】具体的な正極シート１１の作製手順は、図６（ａ）及び（ｂ）に示すように、活物質を溶液に分散混合したスラリーをドクターブレード法により塗布して乾燥することにより後に正極集電体箔になる帯状のＡｌ箔１８の上面に先ず正極活物質１３を形成する。正極活物質１３はＡｌ箔１８の一方の側部を除いて形成され、ポリマー電解質層１７はこの正極活物質１３を被覆する面積を有するように形成される。具体的には、図６（ｃ）に示すように、電解質スラリーは正極活物質１３を覆うように塗布し、その後乾燥することにより正極活物質１３を被覆する面積に形成される。その後図６（ｄ）に示すように、正極活物質１３及びポリマー電解質層１７を有する帯状のＡｌ箔１８は、その正極活物質１３及びポリマー電解質層１７とともに負極シート１４の折畳み面積に相応した面積を有するように切断される。これにより、正極集電体箔１２の表面に正極活物質１３が形成され、その正極活物質１３表面にポリマー電

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解質層１７を有する所定の面積の正極シート１１が複数枚作られる。

【００１８】次いで図５に示すように、ポリマー電解質層１７を間に介装して正極シート１１及び負極シート１４が積層される。この積層は熱圧着により行われる。即ち、負極シート１４に折目の間隔に相応する所定のピッチで複数の正極シート１１を配置し、その状態で所定の温度に加熱された反対方向にそれぞれ回転する一対のローラ１９，１９間に図の実線矢印に示すように通過させ、ポリマー電解質層１７を介装した状態で正極シート１１及び負極シート１４を熱圧着する。複数の正極シート１１の負極シート１４上への配置は、複数の正極集電体箔１２の一方の端部１２ｂがその帯状の負極集電体箔１５の一方の端部１５ｂから突出し、帯状の負極集電体箔１５の他方の端部１５ａが複数の正極集電体箔１２の他方の端部１２ａから突出し、するように、またそれぞれの正極シート１１が負極シート１４の折目に相当する部分をあけて配置される。

【００１９】図４に示すように、このように正極シート１１が積層された負極シート１４の折畳みは、正極シート１１が配置されていない負極シート１４の折目を交互に折曲げることにより行われる。このように折畳むと、複数の正極集電体箔１２の一方の端部１２ｂは帯状の負極集電体箔１５の一方の端部１５ｂから突出し、帯状の負極集電体箔１５の他方の端部１５ａは複数の正極集電体箔１２の他方の端部１２ａから突出した状態で積層される。図３に示すように、このように折畳まれた負極シート１４の折目を除くポリマー電解質層１７の間には、それぞれ折畳み面積に相応した面積を有する複数の正極シート１１が挟持される。そして、負極集電体箔１５の一方の端部１５ｂから突出する複数の正極集電体箔１２の全ての一方の端部１２ｂにはシート状の正極端子２３の一端が接続され、正極集電体箔１２の他方の端部１２ａから突出する複数の負極集電体箔１５の全ての他方の端部１５ａにはシート状の負極端子２１の一端が接続される。この実施の形態における正極端子２３及び負極端子２１にはそれぞれ可撓性を有するエキスパンデッドメタル又は穿孔された金属シートが用いられる。

【００２０】図１、図２及び図４に示すように、複数の正極集電体箔１２の全ての一方の端部１２ｂは積層され、正極端子２３の一端は複数の正極集電体箔１２の積層された全ての一方の端部１２ｂの間に挿入される。そして、正極端子２３の一端が挿入された状態で、その挿入方向と交差する方向に所定の間隔ｔ（図１）をあけて複数個所超音波溶接がなされ、正極端子２３の一端は複数の正極集電体箔１２の全ての一方の端部１２ｂに接続される。この超音波溶接に際して正極集電体箔１２の材質と同一材質であるＡｌからなる厚さが０．０５～０．５mmの補強箔又は補強薄板２４が、正極集電体箔１２の積層された一方の端部１２ｂの積層外面にそれぞれ配

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置され、その補強箔又は補強薄板２４を介して超音波溶接がなされる。

【００２１】一方、複数の負極集電体箔１５の全ての他方の端部１５ａは積層され、負極端子２１の一端が複数の負極集電体箔１５の積層された全ての他方の端部１５ａの間に挿入される。そして、負極端子２１の挿入状態でその挿入方向と交差する方向に所定の間隔ｔ（図１）をあけて複数個所超音波溶接することにより負極端子の一端が複数の負極集電体箔１５の全ての他方の端部１５ａに接続される。この超音波溶接に際して、負極集電体箔１５の材質と同一材質であるＣｕであって厚さが０．０５～０．５mmの補強箔又は補強薄板２２が負極集電体箔１５の積層された全ての他方の端部の積層外面にそれぞれ配置され、補強箔又は補強薄板２２を介して超音波溶接がなされる。

【００２２】この実施の形態における超音波溶接は、その周波数が１０～６０ｋＨｚの範囲内であり、超音波溶接の出力は０．２～５０ｋＷの範囲内で行われ、１回当たりの超音波溶接の面積が５～２００mm²になるように調整される。そして、超音波溶接の所定の間隔は１～１０mmの範囲内で調整される。超音波溶接の際に積層外面に配置される補強箔又は補強薄板２２，２４は、１回当たりの超音波溶接の面積より広い面積を有するように作られ、溶接時における正極集電体箔１２及び負極集電体箔１５のそれぞれに過剰な負荷が加わらないようにされる。

【００２３】図２及び図３に示すように、このように折畳まれた帯状の負極シート１４は複数の正極シート１４とともにパッケージシート２６で密封される。この実施の形態におけるパッケージシート２６は変性ポリプロピレンがラミネートされたアルミニウム箔が用いられる。ラミネートされた変性ポリプロピレンを対向させるようにして一対のパッケージシート２６で折畳まれた帯状の負極シート１４を複数の正極シート１１とともに挟み、真空雰囲気中で重ね合わされたパッケージシート２６の周囲を熱圧着することにより変性ポリプロピレンが互いに熱融着して折畳まれた帯状の負極シート１４は複数の正極シート１４とともにパッケージシート２６で密封される。

【００２４】密封の際、一対のパッケージシート２６は正極端子２３の他端及び負極端子２１の他端がそれぞれそのパッケージシート２６の外部に表出するようにその正極端子２３及び負極端子２１を挟み、その状態で一対のパッケージシート２６の周囲は熱圧着される。この実施の形態では、正極端子２３及び負極端子２１がそれぞれエキスパンデッドメタル又は穿孔された金属シートにより形成されているので、パッケージシート２６の周囲を熱圧着すると、アルミニウム箔にラミネートされた変性ポリプロピレンは熱融解してエキスパンデッドメタルの編み目又は金属シートの穿孔に侵入し、その後変性ポ

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リプロピレンが硬化するのでパッケージ２６と正極端子２３及び負極端子２１の密着性は確保され、そのパッケージ２６による二次電池の密封を確実に行われる。

【００２５】このように構成されたリチウムイオンポリマー二次電池１０では、パッケージシート２６から引出された正極及び負極端子２１，２３の他端を電池の端子として使用することにより所望の電気を得ることができる。ここで、複数の正極集電体箔１２の全ての一方の端部１２ｂ及び複数の負極集電体箔１５の全ての他方の端部１５ａをそれぞれ積層して、正極端子２３及び負極端子２１を接続するが、その接続は、所定の間隔ｔをあけて複数個所超音波溶接することにより行われるので、積層された端部の全ての部分を接合する場合に比較して機械的強度の上昇を抑制することができ、シート状の二次電池１０が従来から有するフレキシブル性を確保することができる。

【００２６】また、正極端子２３の一端は複数の正極集電体箔１２の積層された全ての一方の端部１２ｂの間に挿入され、負極端子２１の一端は複数の負極集電体箔１５の積層された全ての他方の端部１５ａの間に挿入されるので、二次電池１０を繰り返し湾曲させても、正極端子２３とその正極端子２３を挟む正極集電体箔１２の間に、又は負極端子２１とその負極端子２１を挟む負極集電体箔１５の間に隙間が生じることはなく、その接触部分における導電性は確保され、端子接合部における抵抗を十分に低減することができる。

【００２７】更に、超音波溶接に際して、正極集電体箔１２の積層された一方の端部１２ｂの積層外面に補強箔又は補強薄板２４を配置し、負極集電体箔１５の積層された他方の端部１５ａの積層外面に補強箔又は補強薄板２２を配置したので、二次電池１０を湾曲させた場合の、外側における正極集電体箔１２及び負極集電体箔１５の溶接箇所における亀裂等の破損を防止でき、二次電池１０の信頼性を向上させることができる。

【００２８】なお、上述した実施の形態では、所定のピッチで複数の正極シート１１が熱圧着された帯状の負極シート１４を、正極シート１１が配置されていない折目で交互に折曲げたが、正極シートと同形同大の複数の負極シートを正極シートと同じ数用意し、正極活物質と負極活物質との間にそれぞれポリマー電解質層を介在させ、それらのシートを構成する複数の正極集電体箔と複数の負極集電体箔とを積層したものであっても良い。

【００２９】

【実施例】次に本発明の実施例を説明する。

＜実施例１＞先ず複数枚の正極シート１１を作製した。即ち、$LiCoO_2$粉末７０ｇと黒鉛粉末（商品名；ケッチェンブラック）４ｇを、ポリフッ化ビニリデンのＮ－メチルピロリドン溶液に分散混合してスラリーを作製した。一方、フッ化ビニリデン－ヘキサフルオロプロピレン共重合体（エルフアトケム製、Ｋｙｎａｒ２８１０；ヘキサフルオロプロピレン１２ｗｔ％含有品）４０ｇをジメチルカーボネート２００ｇに６０℃で溶解し、更に電解液８０ｇを撹拌混合して電解質スラリーを作製した。次に、幅１０ｃｍ長さが１ｍのＡｌ箔の上面に、活物質を分散混合したスラリーをドクターブレード法により塗布及び乾燥し、更にその正極活物質１３を覆うように電解質スラリーを塗布及び乾燥した。乾燥して正極活物質１３及びポリマー電解質層１７が形成された帯状のＡｌ箔をその正極活物質１３及びポリマー電解質層１７とともに切断して幅が１０ｃｍ長さが１０ｃｍの１０枚の正極シート１１を得た。

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【００３０】次に帯状の負極シート１４を作製した。即ち、燐片状天然黒鉛粉末５０ｇを、ポリフッ化ビニリデンのＮ－メチルピロリドン溶液に分散混合したスラリーを幅１０ｃｍ長さが１ｍのＣｕ箔の上面にドクターブレード法により塗布及び乾燥した後、上述した電解質スラリーを更にその正極活物質１３を覆うように塗布及び乾燥して帯状の負極シート１４を作製した。この帯状の負極シート１４に折目の間隔に相応する所定のピッチで複数の正極シート１１を熱圧着して正極シート１１が配置されていない負極シート１４の折目を交互に折曲げ、幅１０ｃｍ長さ１０ｃｍの折畳み面積を有する帯状の負極シート１４のポリマー電解質層１７の間にそれぞれ幅１０ｃｍ長さ１０ｃｍの１０枚の正極シート１１が挟持された積層体を獲た。

【００３１】この積層体の負極集電体箔１５の一方の端部１５ｂから突出する複数の正極集電体箔１２の全ての一方の端部１２ｂを積層し、厚さ０．１ｍｍのニッケルめっきされた銅線により編まれたエキスパンデッドメタルからなるシート状の正極端子２３の一端をその積層された一方の端部１２ｂの間に挿入し、挿入状態で挿入方向と交差する方向に５ｍｍの間隔をあけて５個所超音波溶接することにより正極端子２３の一端を複数の正極集電体箔１２の全ての一方の端部１２ｂに接続した。また、積層体の正負極集電体箔１２の他方の端部１２ａから突出する複数の負極集電体箔１５の全ての他方の端部１５ａを積層し、厚さ０．１ｍｍのニッケルめっきされた銅線により編まれたエキスパンデッドメタルからなるシート状の負極端子２１の一端をその積層された他方の端部１５ａの間に挿入し、挿入状態で挿入方向と交差する方向に５ｍｍの間隔をあけて５個所超音波溶接することにより負極端子２１の一端を複数の負極集電体箔１５の全ての一方の端部１５ａに接続した。その後正極端子２３の他端及び負極端子２１の他端を表出するようにパッケージ２６で密閉してリチウムイオンポリマー二次電池を得た。この電池を実施例１とした。

【００３２】＜比較例１＞実施例１と同一の手順で実施例１と同一の積層体を得た。この積層体の負極集電体箔１５の一方の端部１５ｂから突出する複数の正極集電体箔１２の全ての一方の端部１２ｂを積層し、実施例１と

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同一のエキスパンデッドメタルからなるシート状の一対の正極端子によりその積層された一方の端部１２ｂを挟み、その状態で一対の正極端子とともに、５０mmの間隔をあけて２個所超音波溶接することにより正極端子２３の一端を複数の正極集電体箔１２の全ての一方の端部１２ｂに接続した。また、積層体の正負極集電体箔１２の他方の端部１２ａから突出する複数の負極集電体箔１５の全ての他方の端部１５ａを積層し、実施例１と同一のエキスパンデッドメタルからなるシート状の一対の負極端子によりその積層された一方の端部１２ｂを挟み、その状態で一対の負極端子とともに、５０mmの間隔をあけて２個所超音波溶接することにより負極端子２１の一端を複数の負極集電体箔１５の全ての一方の端部１５ａに接続した。その後正極端子２３の他端及び負極端子２１の他端が表出するようにパッケージ２６で密閉してリチウムイオンポリマー二次電池を得た。この電池を比較例１とした。

【００３３】＜比較試験＞実施例１及び比較例１のリチウムイオンポリマー二次電池を曲率半径１５ｃｍになるまで湾曲させ、その後逆方向に曲率半径１５ｃｍになるまで湾曲させ、これを１０回繰り返した後、それぞれ３Ａで放電させた。この時の０．５Ａ放電時の容量に対する比を測定した。その結果、実施例１では８０％の放電容量が確保されたが、比較例１では３０％であった。

【００３４】＜評価＞比較例１では実施例１に比較して放電容量が低下していることが判る。これは比較例１における端子が積層された正極集電体箔及び負極集電体箔の端部を挟むように配置され、溶接されているので、電池を湾曲させたことに起因して溶接された部分以外の集電体箔の端部と端子との間に隙間が生じ、その部分における導電性が失われたことに起因しているものと考えられる。一方、実施例１では比較例１に比較して放電容量が高いことが判る。これは実施例１における端子が積層された束ねられた正極集電体箔及び負極集電体箔の端部の間に挿入され、挿入状態で溶接されているので、電池を湾曲させても集電体箔の端部と端子との間に隙間が生じることはなく、集電体箔の端部と端子との間の導電性が十分に確保されていることに起因するものと考えられる。

【００３５】

【発明の効果】以上述べたように、本発明によれば、複数の正極集電体箔の全ての一方の端部及び複数の負極集電体箔の全ての他方の端部をそれぞれ積層し、所定の間隔をあけて複数個所超音波溶接することにより正極端子の一端を複数の正極集電体箔の端部に接続し、所定の間隔をあけて複数個所超音波溶接することにより負極端子の一端を複数の負極集電体箔の他方の端部に接続したので、積層された端部の全ての部分を接合する場合に比較して機械的強度の上昇を抑制することができ、シート状の二次電池が従来から有するフレキシブル性を確保することができる。また、正極端子の一端を複数の正極集電体箔の積層された全ての一方の端部の間に挿入し、負極端子の一端を複数の負極集電体箔の積層された全ての他方の端部の間に挿入したので、二次電池を繰り返し湾曲させても、正極端子とその正極端子を挟む正極集電体箔の間に、又は負極端子とその負極端子を挟む負極集電体箔の間に隙間が生じることはなく、その接触部分における導電性は確保され、端子接合部における抵抗を十分に低減することができる。

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【００３６】また、正極端子及び負極端子をしてそれぞれエキスパンデッドメタル又は穿孔された金属シートを用いれば、端子自体の可撓性を確保してシート状の二次電池のフレキシブル性を確実に確保することができ、正極集電体箔又は負極集電体箔のいずれか一方又は双方の全ての一方の端部の積層外面に補強箔又は補強薄板を配置すれば、二次電池を湾曲させた場合の、外側における正極集電体箔及び負極集電体箔の溶接箇所における亀裂等の破損を防止でき、二次電池の信頼性を向上させることもできる。

【図面の簡単な説明】

【図１】本発明の二次電池を示す斜視図。

【図２】その二次電池を示す図３のＢ－Ｂ線断面図。

【図３】その二次電池を示す図２のＡ－Ａ線断面図。

【図４】その二次電池の構成を示す分解斜視図。

【図５】その負極シートに正極シートが熱圧着される状態を示す斜視図。

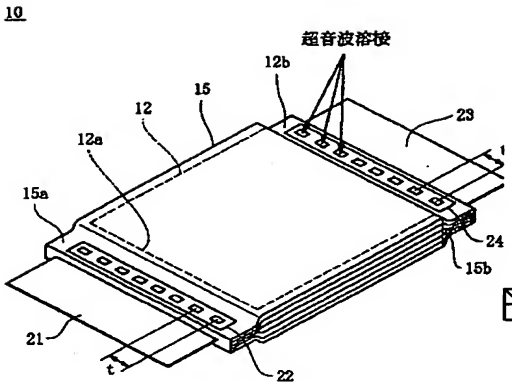
【図６】その正極シートの製造工程を示す図。

【図７】その負極シートの製造工程を示す図。

【符号の説明】

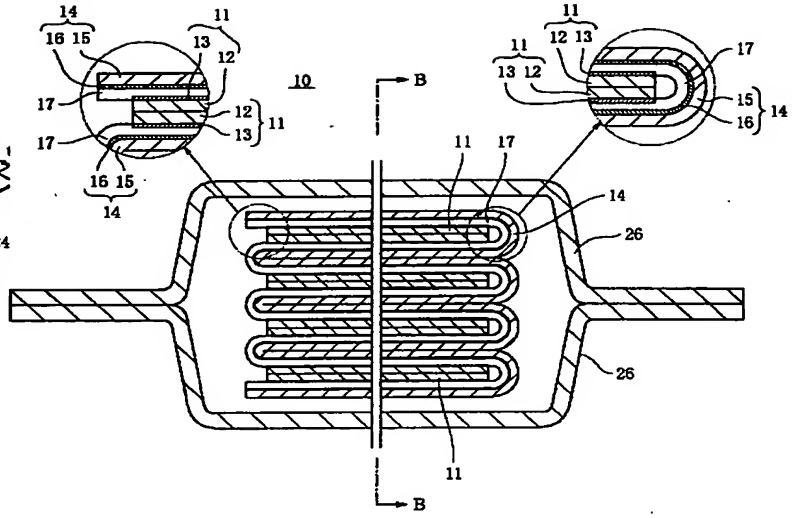
１０　リチウムイオンポリマー二次電池
１２　正極集電体箔
１２ａ　他方の端部
１２ｂ　一方の端部
１３　正極活物質
１５　負極集電体箔
１５ａ　他方の端部
１５ｂ　一方の端部
１６　負極活物質
１７　ポリマー電解質層
２１　負極端子
２２　補強箔又は補強薄板
２３　正極端子
２４　補強箔又は補強薄板
ｔ　所定の間隔

【図１】

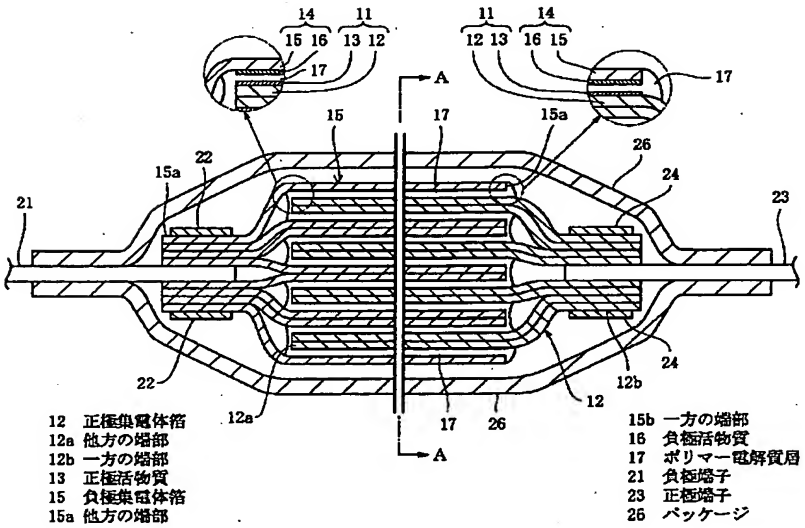


10　リチウムイオンポリマー二次電池
12　正極集電体箔
12b　一方の端部
15　負極集電体箔
15a　他方の端部
21　負極端子
23　正極端子
t　所定の間隔

【図３】

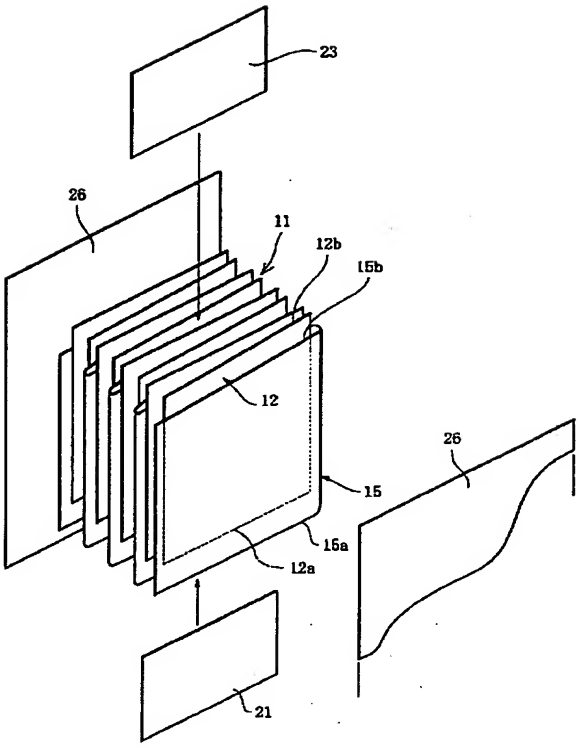


【図２】

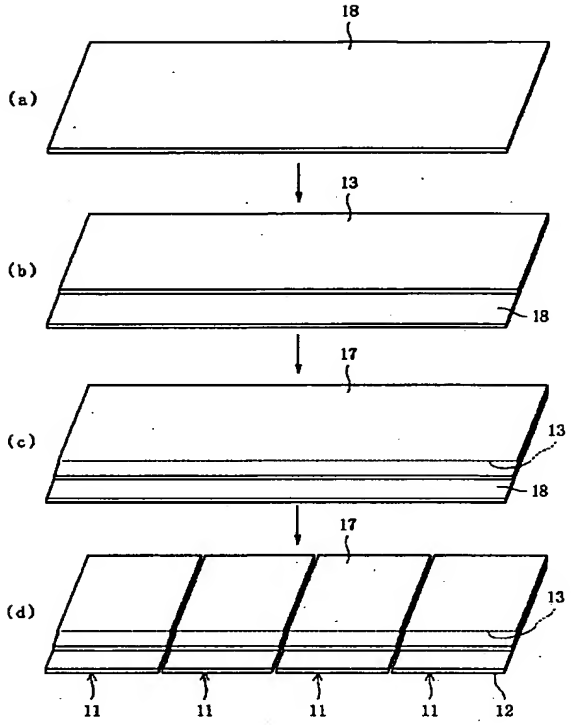


12　正極集電体箔
12a　他方の端部
12b　一方の端部
13　正極活物質
15　負極集電体箔
15a　他方の端部
15b　一方の端部
16　負極活物質
17　ポリマー電解質層
21　負極端子
23　正極端子
26　パッケージ

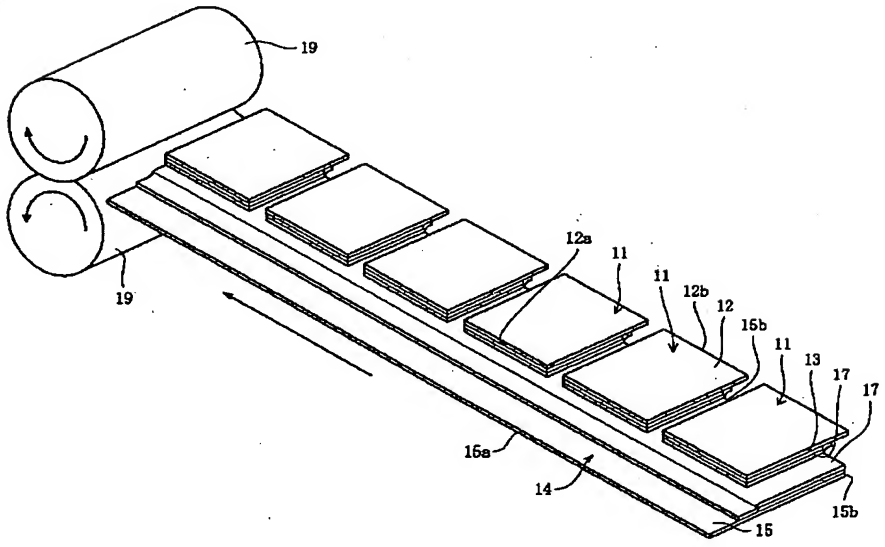
【図４】


23
26
11
12b
15b
12
26
15
15a
12a
21

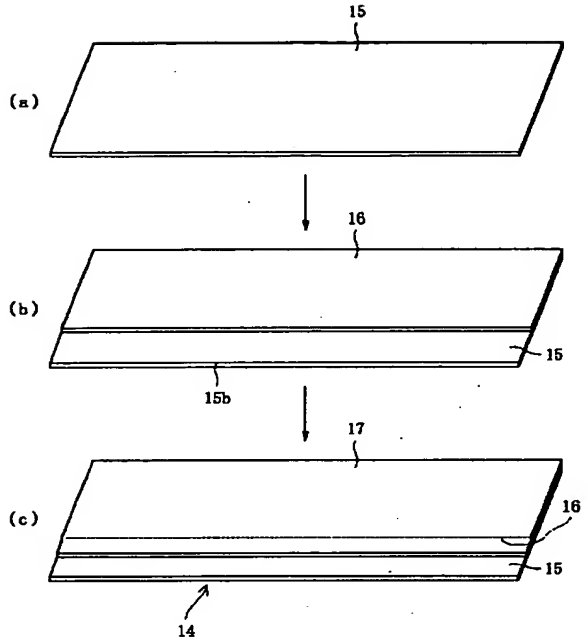
【図６】


18
(a)
13
(b)
18
17
(c)
13
18
17
(d)
13
11
11
11
11
12

【図５】


19
19
12a
11
11
12b
12
15b
11
13
17
17
16a
14
15b
15

【図7】



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